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MATH 360
CP - 9.8

Divergence of $\vec{v}$

$$div(\vec{v}) = \frac{\partial \vec{v}_1}{\partial x} + \frac{\partial \vec{v}_2}{\partial y} + \frac{\partial v_3}{\partial z}$$

Divergence of The Gradient of $\vec{v}$

$$div(\vec{v}) = div(grad(f)) = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$$

The Laplacian

The divergence of the gradient is the Laplacian

$$div(grad(f)) = \nabla^2 f$$

Condition for the Conservation of Mass

The continuity equation:

$$\frac{\partial \rho}{\partial t} + div(\rho v) = 0$$

Steady Flow

If the flow is independent of time, then $\partial \rho / \partial t = 0$ and the continuity equation is

$$div(\rho v) = 0$$

Condition of Compressibility

If the density ρ is constant, so that the fluid is incompressible, then

$$div(v) = 0$$